Case study for continuous data

This case study describes a successful solution to the problem of changing key performance indicators (KPIs). KPIs are simple measures that organizations often compute over time or region to judge their own performance. Companies sometimes set goals around KPIs and reward organizational members when their KPI goals are reached.

The client company in this story historically measured it's performance using a series of survey-based metrics. The client included these metrics in a primary research survey that went out to recent customers. Customers historically rated the client's performance in the following six major topic areas.

"Old" KPI component measures

Topic	Question	Scale
1. Satisfaction	Satisfaction with [software product X]	5-point Likert-type scale
2. Value	Overall value of [software product X]	5-point semantic differential scale
3. Image	Favorability of [software product X]	5-point semantic differential scale
4. Advocacy	Likelihood to recommend [software product X]	5-point Likert-type scale
5. Purchase Intent	Likelihood to repurchase [software product X]	5-point Likert-type scale
6. Quality	Overall product quality of [software product X]	5-point semantic differential scale

The client company used results from the questions above to evaluate different product groups. Results even figured into end-of-year bonuses. The client company developed a composite indicator (actually a weighted average) of the above results that figured into a dashboard of key performance indicators (KPIs).

But then something changed. After a shake-up in management, the company decided to measure and evaluate company performance using more specific estimates of perceived product quality. In addition to dropping the summary quality measure (Topic #6 in the table above), the company also decided to stop measuring "Image" (Topic #3). So, instead of the original six major topic areas above, the "new" KPI component measures included the following seven items:

"New" KPI component measures

Topic	Question	Scale
1. Satisfaction	Satisfaction with [software product X]	5-point Likert-type scale
2. Value	Overall value of [software product X]	5-point semantic differential scale

~~Image~~	~~Favorability of [software product X]~~	~~5-point semantic differential scale~~
3. Advocacy	Likelihood to recommend [software product X]	5-point Likert-type scale
4. Purchase Intent	Likelihood to repurchase [software product X]	5-point Likert-type scale
~~Quality~~	~~Overall product quality of [software product X]~~	~~5-point semantic differential scale~~
5. Reliability*	[software product X] works as expected without crashing or freezing	5-point semantic differential scale
6. Security*	Ease of configuring firewall/other security of [software product X]	5-point semantic differential scale
7. Speed Performance*	[software product X] powers-up quickly when you start it	5-point Likert-type scale

- New KPI component measures never asked before

The new survey went well and the company collected new data on the measures above. But the new management now faced a problem. Once they computed the new composite KPI, the results were different from the previous metric. But because the ingredients to the overall KPI had changed, they couldn't tell whether the change was due to a change in true company performance vs. simple change in how the KPI was measured. Perhaps the company could've thought to include the new measures in earlier surveys (and perhaps delay reporting the new results until they had accumulated a history) so as to enable coincident measures of both composite KPIs over time. Such forethought would enable a KPI calibration. But then again, no matter when one introduces this sort of change, one is always open to the criticism that the new composite KPI wasn't included earlier. And if the company was able to calibrate the new measure, one must decide for how long into the future to keep calibrating the new composite KPI. And looking ahead, what should happen if or when the company decides to change the KPI components again in the future? For a truly continuous and comparable KPI composite measure over time, one would need calibration factors upon calibration factors—one for each wave in which there's a change in KPI definition.

Central Moment, Inc. solved this client's problem through data integration. Specifically, Central Moment integrated the two client surveys containing the different KPI topic areas. Indeed, the key to solving this problem is to recognize that survey respondent perceptions on the new topics of product quality—Reliability, Security, Speed—certainly existed at the time of the original survey. It's just that the client failed to ask respondents about them. And similarly, no doubt that customers still have opinions about the Image and overall Quality of the company's products (the two topics dropped in the new survey). It's just that the company stopped measuring them. Values for these new and old topic areas are simply "latent" or unobserved. They exist; they just happened to not get measured.

Using Bayesian data science techniques and borrowing from the other items in both surveys, Central Moment was able to reconstruct the (unobserved) client ratings on the missing KPI components in both time periods. Central Moment didn't literally go back in time and ask the old survey participants their opinions on the new measures of product Reliability, Security, and Speed. But we did the next best

thing. We gathered knowledge about who completed the survey, what products they own (and for how long), the respondent's purchase history, their industry, as well as all their answers to every other survey question. We then used all this information to estimate how the respondents likely would've answered the omitted survey questions if they had indeed been asked. Hold-out tests using other survey items as a comparison proved our method was remarkably accurate. The end result of this effort was a set of estimates for the new KPI topic areas (Reliability, Security, and Speed) obtained from the sample of "old" KPI survey respondents.

Now with complete data from the old KPI survey—including measures for the new KPI topics—the company could compute year-over-year performance change based on the newly defined KPI. (And it turned out the company's performance didn't truly change as much as it initially feared). There was no need to compute calibration factors. And there was no more regret over failing to include the new topics or survey questions in the "old" survey.   The company could now simply move forward with the new KPI composite metric and compare it to previous waves. Performance bonuses were saved; all were happy.